"Study of Physical, Structural and Spectroscopic Properties of Chemically Synthesized CdO Nanoparticles and it's Application"

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Abstract:

The CdO nanoparticles are to be prepared by using chemical synthetic methods such as sol-gel method, chemical precipitation method. The characterization of cadmium oxide (CdO) is carried out by characterization methods such as XRD (X-ray) diffraction, scanning electron microscope (SEM) for structural and morphological study of CdO nanoparticles. Methods such as U.V. visible spectrometer and photoluminescence spectroscopy will be used to study the various optical properties of CdO nanoparticles.

We have also planned to study the various applications related to CdO nanoparticles.

Introduction:

Cadmium Oxide (CdO) nanoparticles are biologically useful, luminescent material and can be used for multifunctional purposes such as electrodes for storage batteries, ceramic glazes, catalysts, electroplating baths and cadmium salts. Cadmium oxide is an inorganic compound with the chemical formula CdO. It can be found as brown or red crystals or colourless amorphous powder. It is an n-type semiconductor produced by burning elemental cadmium in air.

Nanometer size multifunctional materials are growing the biological fields in various ways. One of the promising and biocompatible semiconductor material CdO has received extensive applications due to its exceptional electrical and optical characteristics in fabricating nanoscale electronic and optoelectronic devices. The semiconductor CdO has wide optical direct band gap (2.5 eV) with large excitation binding energy (75 MeV) [5]. Owing to the above stated properties it is expected to have a wide range of applications at room temperature.

In recent year nanoparticles and semiconducting nanowires hold exciting new prospects for application in sensor arrays for the identification and quantification of single or multicomponent chemical and biological agents.

Because of their small size a few molecules are sufficient to change the electric properties of sensing elements in electronics transducers.

Recently there are several physical or chemical synthetic method of preparing CdO Nano-particle such as thermal evaporation pulsed laser deposition reactive electron bean deposition Ion implantation thermal decomposition and sol-gel technique ultrasonic.

The synthesis of CdO nanoparticles in proposed work we chose sol-gel method because of its simplicity, and possibility of large-area yield at low cost. If needed other methods will be used for synthesis.

Review of Literature and Development of the subject:

M. Tabatabaee *et al.* (2013), studied nano-sized cadmium oxide was synthesized by a simple method using Cd (N .4 O as a reagent in the presence of polyethylene glycol (PEG 2000). The crystal structure consists of face centred cubes and the entire d-line patterns match the reported values. The size distribution and morphology of the sample was analysed by scanning electron microscopy (SEM) and transmission electron microscopy (TEM). Energy dispersive spectrometry (EDS) attached to SEM was employed to perform the elemental analyses of the nanostructured materials. Prepared CdO crystals were grown in face-centred cubes over the range (15-25 nm). By the co-precipitation method used, Cd(OH was formed in a basic medium)

Divine Mbom Yufanyi *et al.,* (2014) prepared cadmium oxide nanoparticle by thermal decomposition method. In this method HMTA (4 mmol, 0.5608 g) was dissolved in 15 mL of ethanol (sonication for 20 min at room temperature). Cadmium nitrate (2 mmol) in 10 mL of ethanol was added drop wise under magnetic stirring. The mixture was stirred for a further 2 h. The white precipitate formed was filtered, washed several times with ethanol and dried in a desiccator over silica gel. A sample of the dry precursor (0.5 g) was ground, placed in a ceramic crucible and calcined at 500 °C (CdO-500). The crucible was placed in the furnace, heated to the desired calcination temperature, and calcination in air continued for 2 h. The sample was allowed to cool down to room temperature in the furnace. The reddish-brown powder obtained could easily be re-dispersed in water and ethanol.

H. Nagabhushan *et al.,* (2016), studied the synthesis of CdO nanostructures via green combustion route using green tea extract as fuel. The whole process takes only minimum time to produce CdO nanoparticles. Due to strong green emission peak, the CdO nanostructures can be utilized in the industry of high-quality monochromatic laser.

N. Thovhogi *et al.,* (2016), studied the first time synthesis of CdO nano-crystals by green chemistry process based on Hibiscus Sabdariffa flower extract. Hibiscus Sabdariffa is a shrub belonging to the family Malyaceae with red flowers in a form calyces. In this plant phenolic compound is present. These phenolic compounds found in the flower includes organic and phenolic acids, such as citric acid, hydroxycitric acid and hibiscus acid.

Methodology Adopted:

Experimental:

The sol-gel process is a more chemical method (wet chemical method) for the synthesis of various nanostructures, especially metal oxide nanoparticles. In this method, the molecular precursor (usually metal alkoxide) is dissolved in water or alcohol and converted to gel by heating and stirring by hydrolysis/alcoholysis. Since the gel obtained from the hydrolysis/alcoholysis process is wet or damp, it should be dried using appropriate methods depending on the desired properties and application of the gel. Thus we are using sol-gel technique for synthesis of cadmium oxide (CdO). Other methods will be used as per requirement.

Importance of study /Society applications:

National Status:

Moumita Ghosh *et al.,* (2004) Nanocrystals of CdO have been obtained by the decomposition of the cupferron complex in the presence of tri-n-octyl phosphine oxide (TOPO) under solvothermal conditions. The precursor: TOPO ratio plays an important role in determining the size of the nanocrystals. The nanocrystals have been characterized by electron

microscopy, absorption spectroscopy and fluorescence spectroscopy, besides X-ray diffraction. The CdO nanocrystals are single crystalline and show evidence for quantum confinement.

RR Salunkhe *et al.,* (2008) Nanocrystalline cadmium oxide (CdO) thin films of different thicknesses were deposited on a glass substrate by a simple chemical method (successive ionic layer adsorption and reaction, SILAR) based on alternate dipping of the substrate in an alkaline cadmium nitrate solution and double-distilled water containing 1% H_2O_2, followed by air heat treatment at 723K for 5h. The cadmium oxide thin films were used as sensing layers for liquefied petroleum (LPG) resistive gas sensors.

International Status:

Wenting Dong *et al.,* (2003) Surface-modified CdO nanoparticles in the size range of 5–10 nm was prepared by a microemulsion method. The direct band gap of the CdO nanoparticles showed blue shift of ∼1.3 eV, comparing with that of the bulk CdO. At room temperature, CdO nanoparticles showed strong emission peaks mainly centred at ∼400 or ∼460 nm, depending on the particles' size.

Min-Hye Kim *et al.,* (2009) We fabricated dye-sensitized solar cells (DSSCs) with SnO2 nano- particles coated with thin layers of CdO on the surfaces into a core−shell-type structure with various Cd/Sn ratios, and studied their effects on the DSSC performance as a function of the CdO shell thickness. CdO is an n-type semiconductor with a conduction band edge lower than that of SnO_2 and, thus, has not been considered as a blocking layer material in the previous studies. The overall conversion efficiency of the DSSC was increased until the Cd/Sn ratio was 0.10, but was dramatically decreased when Cd/Sn was 0.20, compared with that of pure SnO_2. The DSSC with Cd/Sn = 0.05 showed an efficiency of 3.25%, which is improved by 59% from that of pure $SnO_{2..}$

Objective of the Research:

We have planned to synthesis of CdO nanoparticle by using sol-gel method and other techniques to investigation different physical and chemical properties of prepared CdO nanoparticles. We further plan to analyses the role of Cadmium in batteries in order to improve the efficiency of batteries.

Year wise formulation of structure of the study:

2023-2024

The detailed survey of literature of the related field and study
Design of techniques for preparation of CdO nanoparticles.

2024-2025

The CdO particle are prepared by using planned techniques The structural
Morphological spectroscopic characterization will be carried out.

2025-2026

The result and discussion planned work and preparation final draft of the work.

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